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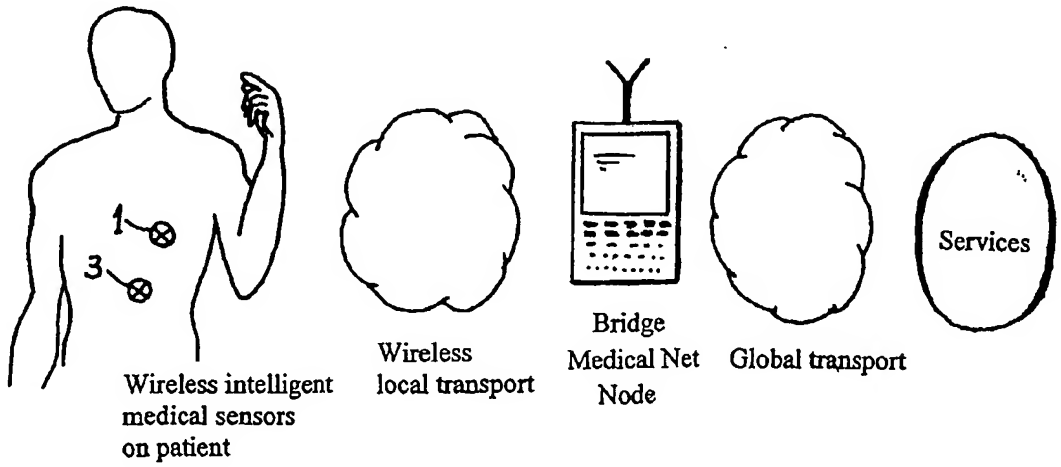
(54) Title: A CLUSTER SYSTEM FOR REMOTE MONITORING AND DIAGNOSTIC SUPPORT



(57) Abstract: A cluster system for wireless, real-time, remote monitoring and recording, analysing a recorded output and responding by feed-back, comprising sensors, processing means, transfer mean, at least one remote receiving station, control means and operating means. The sensors are preferably arranged in a cluster for interactive communication. The system forms a local communication network having access to Internet and is adapted for wireless, remote, real-time two-way data communication between any of the system units and/or through Internet. The two-way data communication is adapted for entering of instructions for acquiring and interpreting data from a number of data sources. In a telemedicine aspect the system uses Wireless Intelligent Medical Sensors (WIMS) for the monitoring of biological parameters and properties.

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For medical and other use as well, these principles and several others are used in many different types of thermometers and thermal sensors on the market, both in disposable and reusable versions and reasonably well suited for advanced monitoring.

Arterial blood pressure

Several ways to measure blood pressure are known to the art. One commonly employed is the non-invasive oscillometric method, using an inflatable cuff around a patient's upper arm, wrist or finger. By varying the cuff air pressure from completely occluding the artery until fully deflated and examining the corresponding external pulsatile pressure changes due to the arterial wall expansions and distensions during each cardiovascular cycle, a relative measure for the systolic (SBP) and diastolic (DBP) arterial blood pressure is given. The absolute values are obtained by the use of calibration factors established by correlation with auscultatory or catheter measurements. In addition the mean arterial pressure (MAP) - when the artery is unexpanded - is estimated. In electronic versions of the device used, pressure transducer means generate electrical signal outputs that follow the magnitude of the pulsatile pressure cycles and are suited for subsequent cardiovascular pulse waveform analysis and/or transfer to a remote site.

Unfortunately disturbance factors or artefacts can give inaccurate blood pressure values. One such factor is caused by vibrations that make it difficult to determine the maximum and minimum pressure, a situation often experienced during emergency transportation.

Electrocardiography (ECG)

The ECG is a medical diagnostic and monitoring aid for recording and interpreting the electrical activity of the heart with the aid of electrodes placed on the skin on specific locations, such as on the chest. Different heart anomalies and disorders can be revealed by deviations from the normal height, form, or duration of the wave patterns. The ECG method is non-invasive and has no contraindications. The sensor systems, including the electrodes, their attachments and the connection cables, are mainly the single-wire or one-lead monitoring type, the 2, 3 Holter lead type for an orthogonal scheme, and the standard twelve-lead type, each with a different electrode commutation scheme. No commercial system can today support all these systems.

The ECG skin surface signals are in the range of 1-10 mV and are accompanied by common mode noise signals up to several volts, differential signal components and a variable DC component up to several hundred mV. For noise suppression a combination of digital and analogous filtering is used, and an ECG system should also be protected from defibrillator pulses at high voltage and have a defibrillation recovery time of not more than 10 sec. ECG safety is defined in EC № EN 60601, safety class 2, type CF.

Temperature

Temperature is a parameter of great importance and represents a vital sign for patient monitoring. The way a patient's temperature is measured is crucial for the accuracy and thereby for scheduling, device specifications and application site, and the provision of reliable diagnostic information therefore will be strongly connected to the choice of measurement strategy. The human core thermal compartment having highly perfused tissues essentially at a uniform temperature lends itself naturally for direct invasive temperature monitoring, for example in the pulmonary artery, the distal oesophagus, the tympanic membrane or the nasopharynx.

Invasive measurements of this type obviously are not practical for the home patient monitoring, but fairly good results also can be obtained by using oral, axillary or bladder temperature measurements. The rectal temperature also normally correlates well with the core compartment temperature, although its measurement no longer is regarded to be so convenient for the home patient use.

At the human skin surface the temperature is considerably lower than in the core. Nevertheless it can often reflect the core temperature reasonably well when biased appropriately, but occasionally the measurement of the skin surface temperature results in unreliable diagnostic figures. Therefore it is important to carefully consider each case and its connected medical requests when selecting the temperature measurement technique.

A number of methods and devices are available for temperature measurements, and a few are listed below:

- Thermocouples offer temperature sensing simplicity and use the Seebeck effect for electrical conductors exposed to a longitudinal temperature gradient.

- Thermistors are inexpensive semiconductors having a highly temperature dependent electrical resistance. Similar but offering higher precision are temperature sensors using a resistive metal element with a positive resistance/temperature coefficient, such as platinum.

- Infrared, non-contact temperature sensors are based on Planck's Law for thermal emission by electromagnetic radiation and are widely used. A typical example is the tympanic or ear thermometer.

- Bimetallic sensors are based on the different thermal expansion of two metals.